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Enhancement of sub grade soil strength using Lime

Harish G R*1

*1Assistant Professor, Department of civil Engineering, New Horizon college of Engineering, Bengaluru, Karnataka, India 560103

ABSTRACT

Subgrade is an important components in the pavement structure. It takes all the load and transfer it into the ground over a larger area. The performance and durability of pavement also depends on type of subgrade soil and its engineering properties. During construction we come across different types of soil among that Black cotton soil also known as expansive soil is one of the problematic soil. In these unavoidable situation improvement of geo mechanical properties are very much essential. Stabilization is one of the method of ground improvement techniques. It this present study stabilization of black cotton soil has been carries out using lime. The test results has been shown that there is an improvement in strength properties of soil and also decrease in plasticity index .substantial increase in CBR value has been observed.

Keywords: Black cotton soil, Lime, stabilization, ucsCBR

I. INTRODUCTION

Due to increase in freight traffic there is a demand for strong and long lasting pavement for better transportation of freight and passengers. To provide better foundation for construction of pavements improvement of geomechanical properties of week soil is very much required and this can be achieved by different methods. Stabilization is one of the conventional and widely used method to strengthen the weak subgrade soils. In this research stabilization of black cotton has been carried out using lime. Several researchers [1-8] concluded that there was substantial increase in strength of soil when treated with lime. In this study lime has been used as stabilizers and introduced in varying percentage to study the strength properties of soil. Engineering properties of soil has been found out as per specifications. UCS test was carried out by varying percentage of lime and cured for different period and test was carried out in both soaked and unsoaked condition and CBR test was carried out after seven days of curing. The engineering properties of soil and grain size distribution of curve is given in table 1 and chart 1respectively.

Table -1: Engineering properties of black cotton soil

Sl No	Property	Values
1	Specific Gravity	2.63
2	H.R.B classification	A-7-6
3	Consistency limits	
	Liquid Limit (%)	65
	Plastic Limit (%)	39
	Plasticity Index (%)	26
5	Compaction Characteristics	
	(1) Modified Proctor Test	
	(a) OMC (%)	22.51
	(b)Maximum Dry Unit Weight (kN/m3)	15.2
7	CaliforniaBearingRatioTest(CBR)	
	(1) unSoaked condition (%)	3.5
	(2) Soaked condition (%)	<2

8	Unconfined compression strength	
	Unsoaked (kPa)	220
	Soaked (kPa)	100

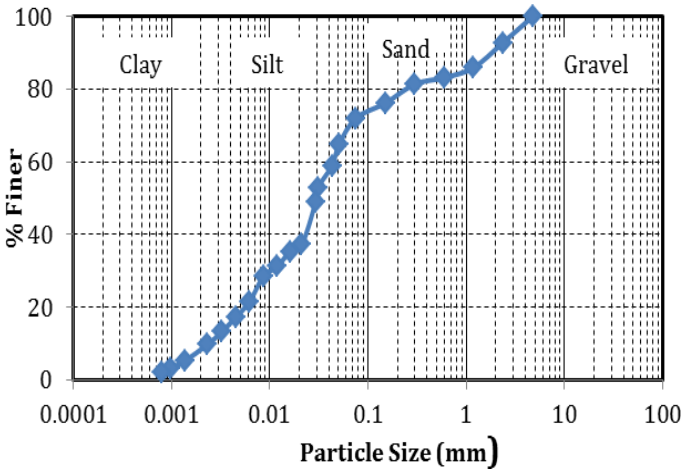

Chart -1: Grain size distribution curve

II. EXPERIMENTALINVESTIGATION

The consistency limits, compaction characteristics, unconfinedcompressivestrengthandCBRvaluesof theLimetreatedblackcottonsoilweredetermined.3, 6and9%ofLIMEwasconsideredforinvestigation.

2.1 Consistencylimits

Chart.2showsthevariationofconsistencylimitswithlim e content.Liquidlimitdecreasesfrom68%to60%,plastic limit increases from 42 % to 50% and plasticity index decreasesfrom26%to9%respectivelyforlime contents varying from 0 to 9%.

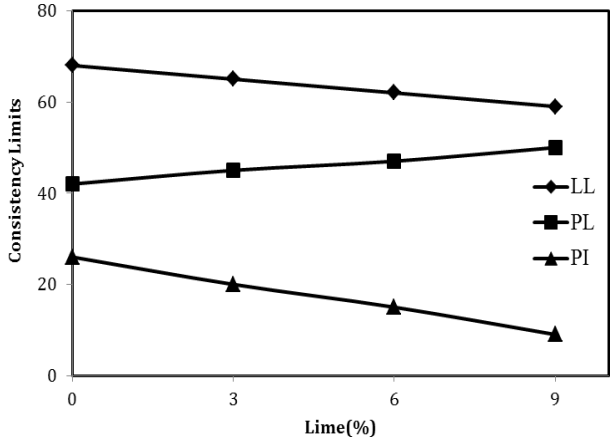

Chart-2:consistencylimits

2.2 Compaction characteristics

Chart 3 shows the comparison of compaction characteristicsuntreatedandlimetreatedblackcotton soil.Itcanbeobservedthat,themaximumdrydensity decreases and optimum moisture content remains almost the same with addition of lime . Particlesare surroundedbyadiffusehydrousdoublelayerandthis is due to the ion exchange of calcium. This reaction alters the density of the electrical charge aroundthe fineparticlesandtheparticlesareattractedcloserto each other to form flocks (flocculation). The soil particlesareslowlycementedincreasingtheparticle resistancecompactiveeffortleadingtoreductioninthe unit weight of thesoil.

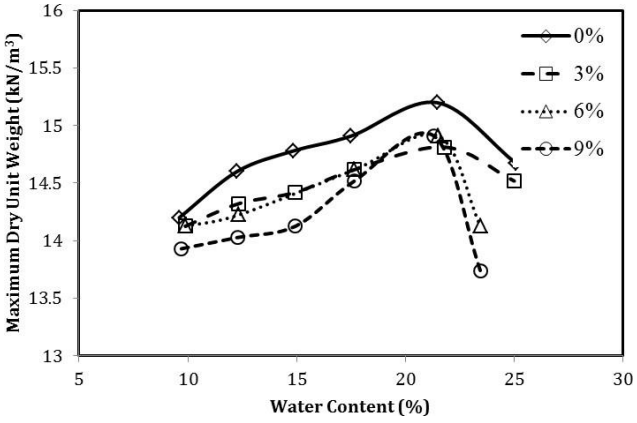

Chart -3: compaction characteristics

2.3 UnconfinedCompressiveStrength

Aseriesofunconfinedcompressivestrengthtestswere carriedoutonuntreatedandlimetreatedblackcotton soilunderbothunsoakedandsoakedconditions.Lime dosagewasvariedbetween3to9%inanincrementof

3%.Thesamplesof38mmdiameterand76mmheight were prepared by static compaction. The prepared samples were tested under unsoaked and soaked conditions. The treated samples were cured for a period of 3, 7, 14 and 28 days in a desiccator to maintain 100% relative humidity. Under unsoaked condition, the samples were directly subjected to testingsoonaftercuring.Undersoakedcondition,the cured samples were covered by a membrane with

porousstoneplacedattopandbottomofthesample. Thesesampleswereplacedinawaterbathsuchthat the water enters from bottom and the samples get saturated by capillary action. The samples were subjectedtosoakingforaperiodofabout24hours.At theendof24hours,thesampleswereretakenoutand subjectedforairdryingforabout30minutesandtest was carriedout

Chart4.showsthevariationofunconfinedcompressiv e strengthoflimetreatedblackcottonsoilwithcuring period and % of lime respectively under both unsoaked and soaked conditions. The unconfined compressivestrengthisfoundtobeincreasedwithan increase in % of lime and it decreased after 6% The strengthincreasedfrom230kPato1300kPaand100 kPato540kPaunderunsoakedandsoakedcondition respectivelywithacuringperiodrangingfrom3to28 daysandfurtherdecreasedafteroptimumdosageof 6%.

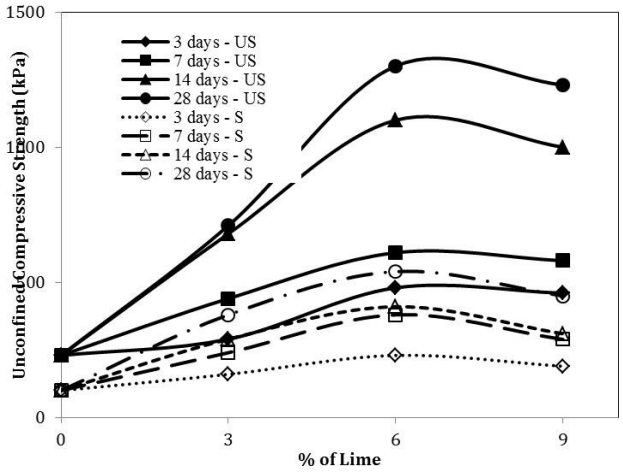

Chart -4: unconfined compression strength

2.3 California Bearing Ratio (CBR)

Chart.5showsthevariationofCBRwith%oflime.The CBR samplestreatedwith3,6and9%oflimewerecuredfor7 daysandthensubjectedtosoakingfor4daysfollowedbyai r dryingandtesting.TheCBRvaluewasfoundtobeincreas ewithanincreaseinlimedosageanditincreasedfrom<2% to 10% with lime content of9%.

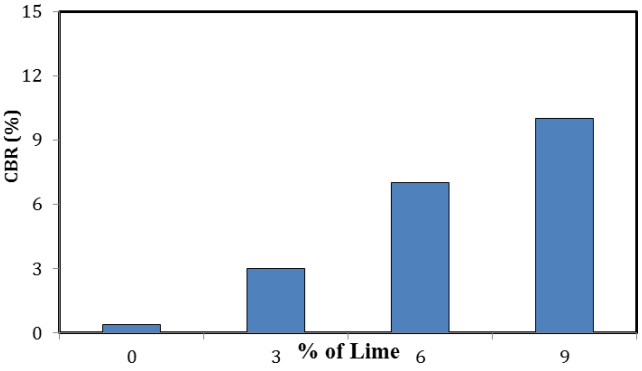

Chart -5: California bearing ratio

I. CONCLUSION

Adetailedexperimentalinvestigationwascarriedout onuntreatedandLimetreatedblackcottonsoil.The consistency limits, compaction characteristics, unconfined compressive strength test, CBR of both untreated and Lime treated black cotton soil were investigated.Basedonthetestresults,followingmajor conclusions weredrawn.

AdditionofLimeimpartedreductioninplasticityinde x and free swell index. At 9% of Lime, plasticity index reduced by17%

The addition of Lime leads to slight reduction inthe maximum dry unit weight when compared with the naturalsoilandthisisduetotheresistanceofferedby theflocculatedstructureofthesoil–lime mixagainst impact.

The unconfined compressive strength of the black cotton soil treated with Lime increased with an increase in the % of Lime and curing period. The strengthincreasedby8timeswithacuringperiodof 28daysunderbothunsoakedandsoakedconditions whencomparedwiththeuntreatedblackcottonsoil. TheCBRofthelimetreatedblackcottonsoilincreased whencomparedtountreatedblackcottonsoilandwith 9%oflime,theCBRof10%wasobtainedwithacuring period of 7days.

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II. REFERENCES

[1] ZhaoHonghua,LiuJun,Guojing,ZhaochunjiandGong Bi-wei (2014) "Reexamination of Lime Stabilization Mechanisms of Expansive Clay" Journal of Materials in CivilEngineering –ASCE

[2] Bulbul Ahmed, Md.AbdulAlim and Md.AbuSayeed (2013) "improvements of Soil strength using Cement andLimeadmixtures"EarthScience2013;2(6):139-144

[3] Niroj Kumar Mishra, SudhirRath and Pradip Kumar Pradhan(2012)"LimeStabilizationofweaksubgradeforConstructionofruralRoads"InternationalJournalof Earth

[4] Martin D. Liu, BuddhimaIndraratna, SuksunHorpibulsku and JirayutSuebsuk (2012) "Variations in strengthofLime-treatedsoftclays"Proceedingsofthe institutionofCivilEngineeers,GroundImprovement, Volume165IssueG14

[5] T.L.Ramdas,N.DargaKumarandG.Yesuratnam(2011) "Geotechnicalcharacteristicsofthreeexpansivesoils treatedwithLimeandFlyash"InternationalJournal of Earth Sciences and Engineering ISSN0974-5904, Volume 04 pp.46-49

[6] PeterisSkels,ThomasIngeman,AndresStuhrJorgense, KasparsBondarsandEdmundSkele(2011)"Quicklime (Cao)StabilizationofFine-GrainedMarineSedimentsin Low Temperature Areas" 3rd International Conference CivilEngineeringproceedings,BuildingMaterials

[7] NadgoudaK.AandHegdeRA(2010)"TheEffectofLime StabilizationonpropertiesofBlackCottonSoil"Indian Geotechnicalconference-2010

[8] MAnjanKumarandGVRPrasadaRaju(2009)"UseofLimeCementStabilizedPavementConstruction"Indian JournalofEngineeringandMaterialsScienceVolume16, pp.269-276